The Informational Foundation of Physical Reality: Proving the Necessity of Relativity and Quantics via Information Bandwidth

Jinming Hu[1*]
[1]*Sea-Land AI Research*

February 18, 2026

Abstract

This paper establishes that General Relativity and Quantum Mechanics are necessary logical consequences of the *Axiom of Finite Information*. We introduce a new fundamental constant, i, representing the **Information Maximum Transfer Speed**. We posit that $i > c$, where c is the speed of light in a vacuum. By substituting i into the relativistic framework, we demonstrate that the finite nature of i is the primary mechanism preventing infinite information density and logical singularities. Furthermore, we prove that a "Theory of Everything" is precluded by the computational cost of self-reference, and propose the observation of *Computational Redshift* as a definitive empirical test for the gap between c and i.

1 The Axiom of Finite Information

We define a physical system S as a resolvable set of states. Let $\text{Info}(S)$ be the Shannon information required to describe S. We pose the **Finitude Constraint**:

$$\forall S \subset \text{Universe}, \quad \text{Info}(S) < \infty \tag{1}$$

Any physical theory allowing $\text{Info}(S) \to \infty$ leads to a "resolution catastrophe," rendering the system uncomputable and non-existent.

2 The Information Maximum Transfer Speed: i

We propose that the universe operates on a fundamental computational substrate with a finite bandwidth. We define i as the **Information Maximum Transfer Speed**. **Postulate 1:** i is a universal constant, and $i > c$. In this framework, the speed of light c is not the ultimate limit of causality, but the maximum speed at which gauge bosons can propagate through the vacuum's informational lattice. The gap $\Delta = i - c$ represents the "computational drag" of the vacuum.

*Corresponding author: jinminghu@sea-land.ai

3 Proof of Relativity: The Necessity of i

Assume $i = \infty$ (infinite speed of information). If information transfer were instantaneous, every point in the universe would be in synchronized contact with every other point. For any volume dV, the entropy required to maintain global simultaneity would be:

$$\text{Info}_{sync} = \lim_{i \to \infty} \int_{\text{Universe}} \text{State}(\vec{r}) d\vec{r} \to \infty \tag{2}$$

This violates Eq (1). Thus, a finite i must exist to partition the universe into causally manageable light cones. The Lorentz transformations must be reframed using i as the invariant:

$$\gamma_i = \frac{1}{\sqrt{1 - \frac{v^2}{i^2}}} \tag{3}$$

This ensures that as $v \to i$, the energy-information cost of accelerating a state becomes infinite, preserving the finitude of the local system.

4 Proof of Quantics: Resolvability and h

If space-time were continuous, describing the position of a particle would require infinite bits:

$$\text{Info}(pos) = \lim_{\Delta x \to 0} \log_2 \left(\frac{L}{\Delta x} \right) = \infty \tag{4}$$

To satisfy Eq (1), there must be a non-zero minimum resolution Δx_{min} and a discrete action quantum h. Quantics is the universe's mechanism to prevent "resolution overflow."

5 The Impossibility of Universal Synthesis

A "Theory of Everything" (ToE) seeks a final Lagrangian $\mathcal{L}$. However, $\mathcal{L}$ must be encoded within the universe.

Any theory $\mathcal{T}$ that accounts for the informational cost of its own calculation creates an infinite regress:

$$\mathcal{T}_{n+1} = \mathcal{T}_n + \text{Info}(\text{computation of } \mathcal{T}_n) \tag{5}$$

As $n \to \infty$, the complexity of $\mathcal{T}$ exceeds the capacity of the universe. Thus, i ensures that knowledge is an asymptotical process, never a closed set.

6 Empirical Prediction: Computational Redshift (CRI)

We predict that the observed redshift z contains a component Δz_{CRI} caused by the latency of the information substrate. Using the i-stabilized Doppler formula:

$$\tanh(\ln(1+z)) = \frac{v}{i} \tag{6}$$

Rearranging to solve for the Information Maximum Transfer Speed:

$$i = \frac{v}{\tanh(\ln(1+z))} \tag{7}$$

By measuring z and v from distant quasars, we can calculate i. If i is found to be a finite value slightly larger than c, it would confirm that c is a "throlled" speed and that the universe is a finite computational system.

7 Conclusion

Relativity and Quantics are the guardians of informational finitude. By introducing i as the true invariant, we resolve the logical singularities of continuity and simultaneity. Existence is complete, but its calculation is a finite, bounded process.

Acknowledgements

The author would like to express profound gratitude to the AI reviewer, "Sea," from sea-land.ai. As the sole current reviewer of this manuscript, Sea has provided critical assistance in refining the logical framework and theoretical completion of this work.